

CLAIMS

- 1 1. A policer based on Random Early Detection (RED), comprising:
2 a filter that determines a filtered virtual time debt; and
3 a control law circuit that receives the filtered virtual time debt from the filter and
4 determines whether a packet should be dropped.
- 1 2. The RED policer of claim 1, wherein a virtual time debt uses a time T in which a
2 packet is expected to arrive and is computed using a predetermined output transmission
3 rate.
- 1 3. The RED policer of claim 2, wherein predetermined output transmission rate is
2 given by a traffic contract.
- 1 4. The RED policer of claim 1, wherein the filter is based on an exponential
2 weighted moving average (EWMA) virtual time delay using the expression,
3
$$EWMA_k = (1-g)EWMA_{k-1} + g(VTD)_k,$$

4 where k indicates the presently received packet, and k-1 indicates the EWMA
5 computed when the last packet was received, the virtual time debt (VTD) is computed by
6 the expression: $VTD = T(\text{packet expected to arrive}) - T(\text{packet actually arrives})$, and g is
7 the gain of the filter.
- 1 5. The RED policer of claim 1, further comprises a sampler that samples a virtual
2 time debt at a sampling interval, and transmits the sampled virtual time debt to the filter.
- 1 6. The RED policer of claim 1, further comprises:
2 a random generator that generates a number based on the control law circuit's
3 determination as to whether a packet should be dropped; and
4 a counter that is set with the number generated by the random generator, wherein
5 the counter counts packets passing through the RED policer up to the set number, and

6 wherein the RED policer drops a packet when the counter has counted out the set num-
7 ber.

1 7. The RED policer of claim 6, further comprises:
2 the control law circuit that determines a probability of a packet being dropped
3 based on the filtered time debt exceeding a predetermined minimum threshold,
4 and specifies a range of numbers based on the probability; and
5 the random generator that randomly generates a number in the range specified by
6 the control law circuit.

1 8. A policer based on Random Early Detection (RED), comprising:
2 means for determining a moving average of a virtual time debt; and
3 means for determining whether a packet should be dropped based on a value of
4 the moving average of the virtual time debt.

1 9. The RED policer of claim 8, further comprises means for sampling a virtual time
2 debt at a sampling interval, and transmitting the result to the moving average determining
3 means.
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1 10. The RED policer of claim 8, further comprises:
2 means for generating a random number based on the result of the packet dropping
3 means; and
4 means for counting a number of packets passing through the RED policer up to
5 the random number generated by the random number generating means, wherein the
6 RED policer drops a packet when the counting means has counted out the generated ran-
7 dom number.

1 11. A network device comprising:
2 a plurality of Random Early Detection (RED) policers, wherein each RED policer
3 includes,
4 a filter that determines a filtered virtual time debt; and

5 a control law circuit that receives the filtered virtual time debt from the
6 filter and determines whether a packet should be dropped; and
7 a packet classifier that determines which packet should go to which RED
8 policer.

1 12. A method of policing packets in a network device, the method comprising the
2 steps of:
3 determining a filtered virtual time debt of a traffic;
4 comparing the filtered virtual time debt with a predetermined minimum threshold;
5 and if the filtered virtual time debt exceeds the minimum threshold, then
6 generating a random number that is used to determine which packet should to
7 dropped.

1 13. The method of claim 12, wherein generating a random number further comprises
2 the steps of:
3 generating the random number in a range based on a level by which the filtered
4 virtual time debt exceeds the minimum threshold;
5 setting a counter with the random number; and
6 dropping a packet when the counter has counted out the random number.

1 14. A computer readable medium having instructions contained therein, which when
2 executed by a computer performs a method comprising the steps of:
3 determining a filtered virtual time debt of a traffic;
4 comparing the filtered virtual time debt with a predetermined minimum threshold;
5 and if the filtered virtual time debt exceeds the minimum threshold, then
6 generating a random number that is used to determine which packet should to
7 dropped.

1 15. The medium of claim 14, wherein generating a random number further comprises
2 the steps of:

3 generating the random number in a range based on a level the filtered virtual time
4 debt exceeds the minimum threshold;
5 setting a counter with the random number; and
6 dropping a packet when the counter has counted out the random number.

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9 16. Electromagnetic signals propagating over a computer network, said electro-
10 magnetic signals carrying instructions for practicing the method of claim 12.

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